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14. ABSTRACT The Student Hands-On Training (SHOT) workshops provided students involved with the AFRL's University Nanosat 5 (UN-5) program with basic space hardware hands-on and in-flight training. In addition participating students were provided with a near-space experience in which they demonstrated science and engineering concepts related to the Nanosatellite missions the developed in the UN-5 program. The primary objective of this program was to help prepare the student participants in the University Nanosat 5 program through the hands-on research activities of this workshop.					
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Program Results Narrative:

The Student Hands-On Training (SHOT) workshops provided students involved with the AFRL's University Nanosat 5 (UN-5) program with basic space hardware hands-on and in-flight training. The objective of both SHOT workshops was to provide these new students exposure to some of the basics of spacecraft construction, the teamwork and coordination involved, as well as the challenges with integration, test and launch of a satellite. During Day 1 and Day 2 of the SHOT I (Year 1) workshop, students constructed a simple ~800 gram satellite called a BalloonSat that was launched to 30 km. Day 3 was devoted to launch, recovery, and data analysis of their BalloonSat. It should be emphasized that the SHOT I training was geared for the novice experimenter. Nevertheless, it provided a complete program from requirements, design, and build, through test, launch and analysis. During the SHOT II workshop, students brought to the workshop a pre-completed BalloonSat that demonstrated one or more of their UN-5 satellite's experiments or technologies. Students launched their BalloonSat on a high altitude balloon. There was a pre-launch and a post-launch presentation by the students. Both SHOT workshops were completed in three days. Participants traveled to Boulder, Colorado, to receive the SHOT training.

The primary objective of this program was to help prepare the student participants in the University Nanosat 5 program through the hands-on research activities of the workshop. Students were organized into teams of four people from the same home institution. Each team was given specific requirements and a schedule. They were also given all the materials needed to create and build a BalloonSat. The workshop provided accommodations for each student. Transportation to the launch site, the recovery site, and back to the university was included.

Each SHOT workshop was completed in three days. For SHOT I, Day 1 and 2 included hands-on training and presentations. The emphasis of this workshop was hands-on training. Day 3 was devoted to the launch and recovery of each team's BalloonSat followed by data analysis and presentation of their results at a post-launch debriefing.

For SHOT II, Day 1 was devoted to the student teams' pre-flight presentations and demonstrations. Day 2 was devoted to launch and recovery of the BalloonSats. Day 3 was focused on post-flight presentations on data received during the flight. All presentations were multi-media and each team had 15 minutes to complete their presentation and demonstration. Day 3 also served as a bad weather flight date.

Each student participating in the three day program was given a handbook and a CD-ROM with all of the information presented during the workshop as well as documents that were referred to in the workshop. Most of the materials used for the construction of each team's BalloonSat were given to the teams at the end of the workshop to be distributed per each team's discretion. Some support hardware was required for this workshop. This hardware was needed to provide mobile tracking and recovery stations for students to track the progress of their BalloonSat in real-time. All launch costs were covered as part of the workshop.

The SHOT workshop for 2007 was a success. The workshop took place at the University of Colorado at Boulder campus on June 14 – 16, 2007. Forty students from the University Nanosatellite 5 Program participated in the workshop. All teams completed their BalloonSats and were launched and recovered.

The SHOT II workshop took place June 13-15, 2008. Student teams participating in the University Nanosatellite 5 Program built payloads at their home institutions. These BalloonSat payloads were designed to include demonstrations and/or experiments directly related to the LEO payloads they are building. Students participated in a Launch Readiness Review prior to launch and completed a Post Launch Review after the launch.



During the SHOT I workshop, 39 students from 10 schools came to Boulder, Colorado on June 14 - 16, 2007. Students' experiences were very positive as reported in the completed student surveys. 10 BalloonSats were built and launched on a high altitude balloon to 100,000 feet. All BalloonSats were recovered and recorded temperature, humidity, voltage, and imagery data.

During the SHOT II workshop, 38 students from 9 schools came to



Boulder, Colorado on June 13 - 15, 2008. These students presented their BalloonSat systems and mission on June 13, 2008 at a Launch Readiness Review. 9 BalloonSats, weighing on average 1.8 kg, were launched on two high altitude balloons. All BalloonSats were recovered and most recorded mission data. Each student team presented their results during the SHOT II Post Launch Review on June 15, 2008. Each student team presentation is published on the SHOT website. Many of the student teams learned from their flight data valuable information related to their University Nanosatellite 5 program.

The SHOT workshops utilized facilities on the campus of the University of Colorado at Boulder. The SHOT workshops required the use of one large auditorium, three classroom labs and two meeting rooms. The University charged small usage fees for each of these facilities and were included in the budget.

Not considered a traditional facility, but treated as such for these workshops, was the location used for the balloon launch, its required launch site and support, as well as the necessary landing site support. Launch took place at the high school in Deer Trail, Colorado. Fees were associated with this launch facility for use of restrooms, power, and fields. These fees were included in the budget in launch costs.

Much of the equipment used in the SHOT workshops was for the hands-on activities. For SHOT I, this equipment was assembled into a kit and each team was given one kit to construct their BalloonSat. These kits included many items. The more costly items are listed below:

- Digital Camera
- Soldering Kit
- Timing Circuit kit
- Science Experiment Kit
- HOBO Computer and software
- Batteries
- Glue gun and foam core

The BalloonSat kit was given to each team during the SHOT I workshop. The kit was divided up among the team members and taken home at the conclusion of the workshop.

Other support equipment was necessary to support the SHOT workshops. This included items such as extension cords, cables and additional soldering irons. Other equipment was needed to support launch and recovery efforts. This equipment served as a tracking system and contains radios, terminal node controllers, 12 V DC power supplies, GPS unit, computer, and magnetic mount antenna. Several of these items were used during the hands-on activities associated with the HOBO loggers and science experiments. This equipment is maintained and used again for future SHOT workshops.